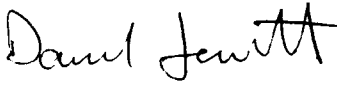



Report Interim Progress Report on Year 1
Title Irregular Satellites of the Planets / NNG04GLI18G
PI David Jewitt 
Inst Institute for Astronomy, University of Hawaii

Dates 05/01/04 - 04/30/05 (Year 1)

Progress in Year 1 of this grant

This proposal is directed towards the observational exploration of the irregular satellite systems of the planets. Primarily we use large-format CCD cameras on the world's largest telescopes, on Mauna Kea, to discover new irregular satellites and then to monitor their positions in order to ascertain their orbital characteristics. Separate observations are taken to determine the physical properties of the irregular satellites. The big-picture science objective is to determine how these satellites were captured, and to use the properties of the satellites and their orbits to place constraints on early solar system (including formation) processes.

Work in the first year has focussed on a major investigation of the Saturn irregular satellite system. We secured observing time on the Subaru and Gemini 8-m diameter telescopes in December 2004, January, February and March 2005 for the conduct of a deep, wide-area survey. This has resulted in the detection and orbit determination for 12 new satellites to be announced in the next week or two. Additional satellites were lost, temporarily, due to unusually poor weather conditions on Mauna Kea. These objects will be recovered and their orbits published next year.

A separate survey of the Uranus irregular satellites was published (Sheppard, Jewitt and Kleyna 2005).

Away from the telescope, we have discovered the amazing result that the four giant planets possess similar numbers of irregular satellites. This flies in the face of the standard gas-drag model for satellite capture, since only two of the giant planets are gas giants and the others (Uranus and Neptune) formed by a different process and in the absence of much gas. The constancy of the satellite number (each giant holds ~100 irregular satellites measured down to the kilometer scale) is either a coincidence, with different capture mechanisms at different planets giving by chance the same total numbers of irregular satellites, or indicates that the satellites were captured by a completely different process. We favor the latter (Jewitt and Sheppard 2005).

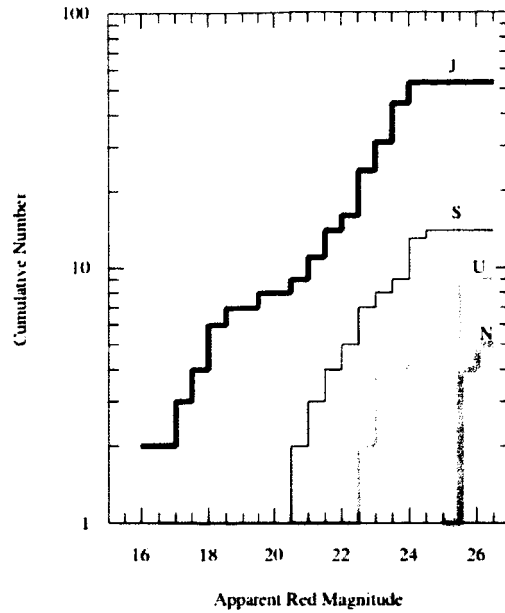


Figure 1 Cumulative numbers of irregular satellites brighter than a given apparent red magnitude (binned in 0.5 mag increments) for each of the giant planets (J,S,U,N = Jupiter, Saturn, Uranus, Neptune). Data determined primarily from Hawaii surveys. From Jewitt and Sheppard (2005).

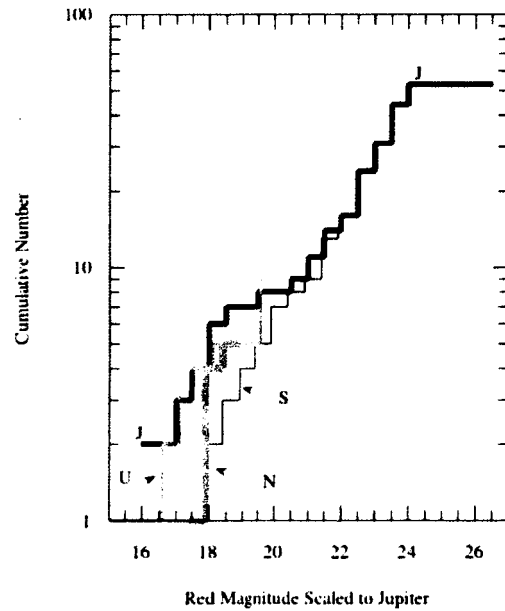


Figure 2 Same as Figure 1 but with the magnitudes of the satellites scaled to the opposition heliocentric and geocentric distances of each planet. The overlapping of the curves shows the similarity of the satellite populations.

Work done under this grant also contributed to the PhD of Scott Sheppard, now a Hubble Postdoctoral Fellow at the Carnegie Institute of Washington/Department of Terrestrial Magnetism.

Publications

- D. Jewitt and S. Sheppard (2005). Irregular Satellites in the Context of Giant Planet Formation. ISSI Conference on the Outer Solar System. Ed. R. Kallenbach, in press (May 2005)
- S. Sheppard, D. Jewitt and J. Kleyna (2005). Ultra-deep Survey for Irregular Satellites of Uranus: Limits to Completeness. *Astronomical Journal*, 129, 518-525.

Research Planned for Year 2

In Year 2 we will attempt the following:

- 1) We will re-examine Saturn at Subaru and Gemini, to recover the lost satellites and to obtain astrometry from which the orbits of all the irregulars can be better defined.
- 2) We will use these improved and more numerous orbits to search for new dynamical families in the satellite system.
- 3) We will use the Subaru 8-m to conduct an ultra-deep survey for irregulars at Uranus, with the prime objective being to compare the Uranus system with the satellite system of Saturn on an equal (distance scaled) magnitude basis.
- 4) We will write papers on these works and submit them for publication.